

SIBERIAN STATE AEROSPACE UNIVERSITY
RUSSIA, KRASNOYARSK

Cancer risk assessment in Krasnoyarsk city

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GOAL OF WORK

This work investigates the influence of urban air pollution on cancer mortality in the Krasnoyarsk City



Krasnoyarsk is an industrial city in eastern Siberia with about 1 million people.

DATA

Air pollution

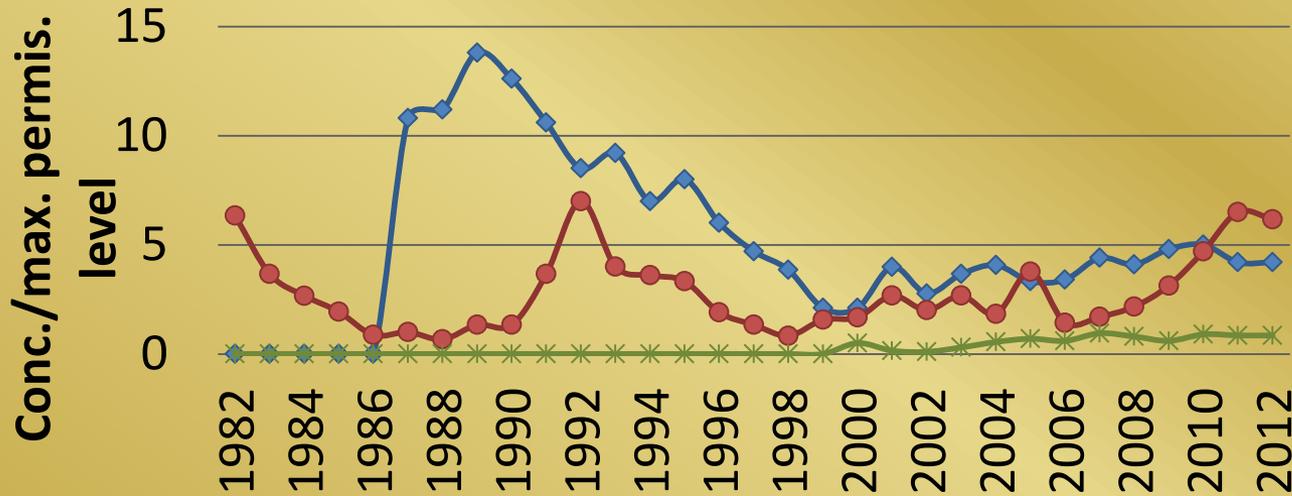
Concentrations of 21 pollutants from eight stationary posts located throughout the Krasnoyarsk city from 1986 to 2012:

NO_x, CO, SO₂, xylene, toluene, phenol, Mn, Cu, Zn, Fe, Mg, Pb, benzo[a]pyrene, formaldehyde, benzene, ethylbenzene

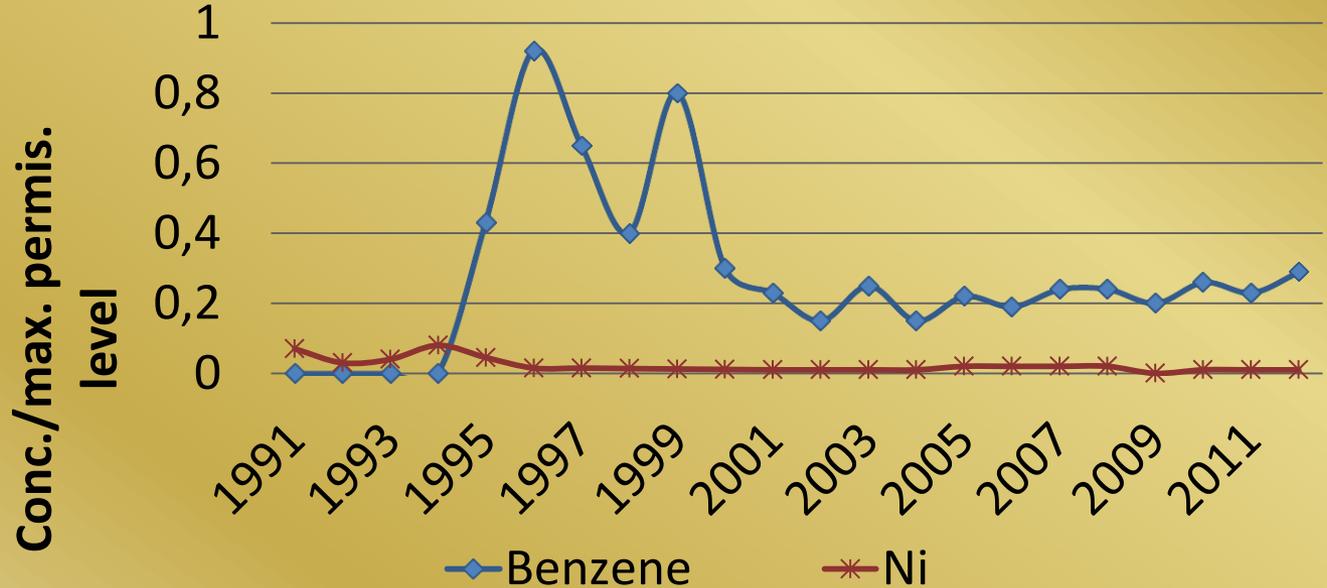
Human health

Number of deaths for 26 groups of cancer from 2000 to 2012 for Krasnoyarsk citizens

AIR POLLUTANT CONCENTRATIONS WITH CANCER EFFECT IN KRASNOYARSK CITY (annually)



benzo[a]pyrene formaldehyde ethylbenzene



MAIN SOURCES OF CARCINOGENIC SUBSTANCES IN KRASNOYARSK CITY

AIR POLLUTION SOURCES	Benzene, %	ethylbenzene, %	formaldehyde, %	benzo[a]pyrene, %	nickel, %
Refueling stations	45	3,23	-	-	-
Manufacturing industry	-	28,22	24,07%	-	3,43
Aluminum industry	-	-	-	98,6	-
Car exhaust	-	-	64,7	0,26	
Engineering industry	-	-	-	-	94,27
Domestic solid waste	-	61,2	-	-	-
Electro power stations	-	-	-	-	0,83
Building materials industry	-	-	6,25	-	-
Others sources, %	55	7,35	4,98	1,14	1,47
<i>Total, t/y</i>	<i>7,170</i>	<i>5,235</i>	<i>81,074</i>	<i>1,969</i>	<i>0,004</i>

ANNUAL DYNAMICS OF NUMBER OF CANCER DEATHS IN KRASNOYARSK CITY

Year	Number of death from cancers, % from total mortality	Number of deaths for some groups of cancer, % from cancer mortality			
		digestive system	respiratory system	reproductive system	Hemato-poietic system
2000	14.5	20.6	23.0	12.1	2.3
2001	15.0	24.4	21.9	12.7	2.9
2002	13.9	21.0	23.9	12.0	2.5
2004	16.4	21.3	19.7	13.1	2.9
2006	17.4	19.9	20.3	15.2	3.4
2008	18.5	20.7	20.1	14.0	2.5
2010	18.5	21.5	20.4	14.0	2.7
2012	18.9	19.7	19.6	13.8	3.2

METHODS FOR ANALYSIS

1. To determine the pollutants are linked with cancer mortality we calculated correlation between all pollutants and a number of deaths from any group of cancer.
2. To check our results, we studied the works on clinical cancer research on different Russian medical institute and IARC database.
3. To estimate the time lag in the pollution-mortality association we used cross-correlation function.

CARCINOGENIC SUBSTANCES AND ORGAN TARGETS

Pollutants	Organ targets (calculated data)	Organ targets (published data)
Benzo[a]pyrene	breast, lungs, stomach, prostate, esophagus	breast, lungs, stomach, thyroid, prostate, esophagus
Formaldehyde	leukemia, larynx	larynx, nasopharynx, leukemia
Ni	lungs, stomach, larynx	nasopharynx, lungs, stomach, larynx
Benzene	lymphoma	lymphoma
Ethylbenzene	larynx, liver, ovary	nasopharynx, liver, lungs, kidney, thyroid, ovary
Cr	lungs	lungs
Pb	larynx, leukemia, lymphoma esophagus	immune system, lung, stomach, kidney, brain of nervous system, endocrine function, hematopoietic system

TIME LAG IN THE POLLUTION-MORTALITY ASSOCIATION (CANCEROGENIC TO HUMANS)

Pollutants	CANCER MORTALITY OF					
	respiratory system (lungs, larynx)	hematopoietic system (leukemia)	digestive system (stomach, liver, pharynx)	immune system (limphoma)	brain and nervous system	bones
benzo[a]pyrene			0 – 1 and 14 – 16	0 – 1	15 – 16	15 – 16
benzene			7	3 – 7	7	9
formaldehyde	7		0 and 16		12	
Cr	2		2 and 10	3	13	11
Pb	4	14	0 – 3	0		14
Ni	2		2			11

Numbers are time lags, years

TIME LAG IN THE POLLUTION-MORTALITY ASSOCIATION (LIKELY TO BE CANCEROGENIC TO HUMAN)

Pollutants	CANCER MORTALITY OF				
	respiratory system (lungs, larynx)	hematopoietic system (leukemia)	digestive system (stomach, liver, pharynx)	immune system (limphoma)	reproductive system (prostate)
ethylbenzene	3		0 – 5	0	0 – 1
phenol	8	6	5 – 9	5 – 9	7
xylene	3	6	3		7
toluene			0	0	

Numbers are time lags, years

TIME LAG IN THE POLLUTION-MORTALITY ASSOCIATION (NON- CANCEROGENIC)

Pollutants	CANCER MORTALITY OF					
	respiratory system (lungs, larynx)	digestive system (stomach, liver, pharynx)	immune system (limphoma)	reproductive system (prostate)	central nervous system	bones
Fe		0 – 5	0 – 4	0 – 2		
Zn		0 – 1	0	0 – 1	13	
Mn		0 – 7	0 – 6	0 – 2	14	13
Cu		1 – 5, 11 – 12	1 – 3		11 – 12	11 – 12
SO ₂	1	1				
NO	11	2 – 3	2	2		
NO ₂		2 – 6	2 – 5	3 – 4		14

Numbers are time lags, years

CONCLUSIONS

1. The analysis of air pollution dynamic shows that the air quality in Krasnoyarsk city has deteriorated last years. The concentration of some pollutants increased by a factor of 2 and 4. It can be tell the air quality returned to 20 years ago.
2. Digestive and respiratory system have the most contribution to the number of cancer death and their contribution increases last years.
3. It was selected 17 pollutants that have influence on numbers of cancer mortality and 16 group of cancer that have connection with specially pollutants.
4. It was shown that air pollution has the greatest influence on digestive and respiratory system. The time lag for digestive system is less than for other system and it varies in the range from 0 to 5 years
5. We can expect the increasing the numbers of cancer death from digestive and immune systems caused by increasing concentration of benzo[a]pyren, formaldehyde, ethylbenzene after 6-8 years.

Thank for your attention

